

What is claimed is:

1. A differential (40) comprising:
  - a die formed differential housing (44) having a spherical inner volume (110);
  - a subassembly (200) disposed in the spherical inner volume (110), the subassembly (200) including at least one pinion shaft (56), at least one pair of bevel pinions (60) disposed on the at least one pinion shaft (56) and at least one pair of bevel gears (64) linked with the at least one pair of bevel pinions (60);
  - a die formed housing cover (68) attached to the die formed differential housing (44) for enclosing the subassembly (200) within the differential housing (44); and
  - a ring gear (48) connected to the differential housing (44) for transmitting torque from a prime mover.
2. The differential of claim 1 wherein the housing (44) includes a cup-shaped body (104) defining the spherical inner volume (110) and a hub portion (124) extending from the cup-shaped body (104) for receiving an axle.
3. The differential of claim 2 wherein the differential housing (44) includes a laterally extending flange (46) for connecting the ring gear (48) to the differential housing (44).
4. The differential of claim 2 including a cylindrical flange (112) formed on the differential housing (44) for connecting the ring gear (48) to the differential housing (44).
5. The differential of claim 2 wherein the cup-shaped body (104) includes a spherical inner portion (112) and a conical support portion (116).
6. The differential of claim 5 wherein the housing (44) includes a ledge (144) formed on the conical support portion (116) of the housing (44) for mating with the housing cover (68).

7. The differential of claim 6 including journals and bores (136) formed in the differential housing (44) for receiving the pinion shaft (56).
8. The differential of claim 7 including oil lubrication holes (140) formed in the differential housing (44).
9. The differential of claim 2 wherein the subassembly (200) includes a washer (66) having a complementary shape to the differential housing (44) disposed between the bevel pinions (60) and bevel gears (64) and the differential housing (44).
10. The differential of claim 2 wherein the housing cover (68) includes a cup-shaped body (160) and a hub portion (168) extending from the cup-shaped body (160) opposite the hub portion (124) of the housing (44) for receiving an axle.
11. The differential of claim 10 wherein the housing cover (68) includes a spherical inner portion (164) and an edge (184) formed thereon for contacting and mating with the ledge (144) on the differential housing (44).
12. The differential of claim 11 including journals and bores (192) formed in the housing cover (68) for receiving the pinion shaft (56).
13. The differential of claim 12 including oil lubrication holes (188) formed in the housing cover (68).
14. A method of manufacturing a differential (40) comprising the steps of:
  - die forming a differential housing (44) from a blank (100), the differential housing (44) including a spherical inner volume (110) and a hub portion (124) having a bore (120);
  - die forming a housing cover (68) from a blank, the housing cover (68) including a hub portion (168) having a bore (161);
  - assembling a sub-assembly (200) of at least one pinion shaft (56), at least two bevel

pinions (60) and at least two complementary bevel gears (64);

inserting the sub-assembly (200) into the spherical inner volume (110) of the differential housing (44) such that the bore (136) of the housing (44) aligns with an inner splined aperture on one bevel gear (64) to receive a splined portion of an axle;

fitting the housing cover (68) to the differential housing (44) to enclose the sub-assembly (200) such that the bore (192) of the housing cover (68) aligns with an inner splined aperture on another bevel gear (64) to receive a splined portion of another axle;

attaching the housing cover (68) to the differential housing (44); and

connecting a ring gear (48) to the differential housing (44).

15. The method of manufacturing a differential of claim 14 wherein the ring gear (48) is connected to the differential housing (44) by rivets (52).

16. The method of manufacturing a differential of claim 14 wherein the ring gear (48) is connected to the differential housing (44) by welding via a weld bead (216).

17. The method of manufacturing a differential of claim 14 wherein the die forming step for the differential housing (44) includes a plurality of die forming operations.

18. The method of manufacturing a differential of claim 15 wherein the plurality of die forming operations includes:

providing a ductile disk shaped blank (100);

die forming the blank (100) to form a cup shaped body (104) having a flange (46, 212), a conical portion (116), spherical inner portion (112), and a small central bore (120);

die forming the cup shaped body (104) forming a hub portion (124);

machining the hub portion (124) forming a journal and shoulder (130);

machining the cup shaped body (104) forming attachment points (132) for the ring gear

(48);

machining the cup shaped body (104) forming bores (136) for the pinion shafts (56);

machining the cup shaped body (104) forming oil lubrication holes (140);

machining the cup shaped body (104) forming a ledge (114) for attaching to the housing cover (68).

19. The method of manufacturing a differential of claim 14 wherein the die forming step for the differential housing cover (68) includes a plurality of die forming operations.

20. The method of manufacturing a differential of claim 17 wherein the plurality of die forming operations includes:

providing a ductile disk shaped blank;

die forming the blank to form a cup shaped body (160) having a spherical inner portion (164), and a hub portion (168);

machining the inner portion (164) to a desired shape (172);

machining the hub portion (168) forming a journal and shoulder (176);

machining the cup shaped body (160) forming an edge (184) for contacting the differential housing (44);

machining the cup shaped body (160) forming oil lubrication holes (188);

machining the cup shaped body (160) forming journals and bores (192) for receiving the pinion shaft.

21. The method of manufacturing a differential of claim 14 including the step of installing bushings (202) and bearings (204) to the hubs (124, 168) of the differential housing (44) and housing cover (68).

22. The method of manufacturing a differential of claim 14 including the step of heat treating

the differential housing (44) and housing cover (68).